REMARKS

The specification of the subject U.S. patent application, as filed, as constituted by the verified translation of PCT/DE2003/004098 has been cancelled in favor of the concurrently submitted Substitute Specification. A suitable Abstract of the Disclosure has been added. These changes and additions do not constitute any new matter.
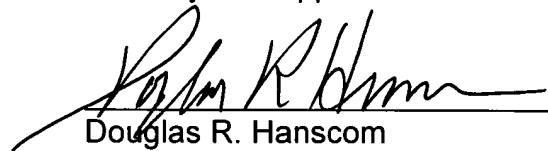
Claims 1-43 of the application as originally filed have been cancelled. New claims 44-85 have been added. Claims 44-85 are essentially the same as the claims now pending in the PCT application. They have been rewritten in a form more in accordance with U.S. practice and eliminating multiple dependencies.

Entry of this Preliminary Amendment into the file of the subject U.S. patent application, prior to the calculation of the filing fee, and prior to an examination of the application on the merits, is respectfully requested.

Respectfully submitted,

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ABSTRACT OF THE DISCLOSURE

A method for controlling the temperature of a machine part, by the use of a regulating device, is accomplished by determining one respective value of a measured temperature at each of two separate spaced-apart measured points, which two points are located along a control distance. One of these measured values is fed to each of two control circuits of the regulating device which two control circuits are connected to each other in a cascade-type manner.

MARKED-UP COPY OF SPECIFICATION
MÜLLER: W1.2107 PCT-US

[Specification]

TEMPERATURE CONTROL[TEMPERING] METHOD, REGULATING[CONTROL] DEVICE AND TEMPERATURE CONTROL[TEMPERING] DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[001]   This patent application is the U.S. national phase, under 35 USC 371, of

PCT/DE2003/004098, filed December 11, 2003; published as WO 2004/054805

A1 on July 1, 2004; and claiming priority to DE 102 58 927.5, filed December 17,

2002 and to DE 103 28 234.3, filed June 24, 2003, the disclosures of which are

expressly incorporated herein by reference.

FIELD OF THE INVENTION

[002]   The present invention is directed[relates] to a method for controlling a

temperature, to a regulating device, as well as to a device for controlling a

temperature[in accordance with the preambles of claims 1, 4, 21 or 31].

BACKGROUND OF THE INVENTION

[003]   A device and a method for the temperature control of a component of a

printing press is known from DE 44 29 520 A1. The[, wherein the] temperature of

the component is controlled by use[means] of an at least partially circulating fluid.

An actuating member, by use[means] of which a mixture ratio between two fluid

flows at different temperatures can be adjusted at a feed-in point, is controlled via

a temperature measuring point arranged between the feed-in point and the

component.

[004]   EP 0 886 577 B1 discloses a device and a method for controlling the

temperature of a component. A[, wherein a] component temperature is monitored

by [means of]sensors and the measured value is sent to a control unit. If the

temperature measured at the component differs from a command variable, the

control unit lowers or increases the temperature of a coolant in a cooling unit by a

defined value, waits for a length of time and repeats the measurement and the

mentioned steps until the control variable has again been attained.

[005]   A temperature control device for printing presses is known from EP 0 382

295 A2. A[, wherein a] temperature of the fluid in an inflow section, and a surface temperature of the component whose temperature is to be controlled are detected and are supplied to a control device. A[An] manipulated variable for regulating a mixing motor is determined on the basis of these temperatures, as well as possibly predetermined disturbance variables, such as the paper used, the percentage of dampening agent and target temperatures, which set the relationship between the fluid conducted in the circuit and freshly temperature-controlled fluid.

[006]   JP 60-161152 A discloses a cooling device for a roller whose temperature is to be controlled. A[, wherein a] surface temperature of the roller, as well as a fluid temperature in the inflow path, are measured and are supplied to a regulating device for comparison with a command variable and for controlling a valve.

SUMMARY OF THE INVENTION

[007]   The object of the present invention is directed to providing[based on

creating] a method for controlling a temperature, a regulating device, as well as a

device for controlling a temperature.

[008]   In accordance with the present invention, this object is attained by

measuring temperature values at several selected points. These values are

provided to a regulating device that has at least two regulating circuits. These at

least two regulating circuits are connected to each other in a cascade-like manner.

The temperature measuring points are spaced apart from each other in a

measuring section[means of the characteristics of claims 1, 4, 21 or 31].

[009]   The advantages to be gained by [means of]the present invention lie, in

particular, in that the regulating device operates very rapidly and dependably,

even over existing extended conveying distances for the temperature control

medium. The short reaction time allows its[the] employment in applications and

processes with large dynamic components. Thus, the instant temperature control

is of great advantage even in cases where it is necessary to follow rapid changes

of a temperature command variable and/or where external conditions, such as the

energy yield, because of friction or external temperatures, change very rapidly.

[010]   The rapid regulation in spite of a possibly extended conveying distance

for the fluid is achieved for one in that further regulating circuits, and, in particular,

two regulating circuits, underlie a regulating circuit monitoring the temperature at

the component. Also, in a simplified embodiment, the direct determination of the

temperature can be omitted and a further regulating circuit can underlie a

regulating circuit that is monitoring the temperature at the entry to the component.

Thus, the regulating path from the location of the preparation of the temperature

control medium (mixing, heating, cooling) to the destination, such as, for example,

the component itself or the entry to the component, is therefore divided into

several partial paths and partial running times.

[011]   It is of great advantage here that an innermost regulating circuit monitors

the temperature of the temperature control medium during its preparation (mixing,

heating, cooling) at a very close distance and regulates it, so that an error possibly

occurring during processing is [already]detected at the start of the conveying path

and is removed by regulation, instead of the error[and is] not being detected and

steps being taken[are] only taken when it reaches the component.

[012]   Embodiments of the present invention are of particular advantage

wherein a pre- regulation in regard to the heat flow (losses), in regard to the

running times, and/or in regard to the number of revolutions of the machine takes

place. A further acceleration of the regulating process can be achieved by a pre-

regulation with[in] regard to an amplitude excess and/or with[in] regard to the

inclusion of the return temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

[013]   Preferred[Exemplary] embodiments of the present invention are

represented in the drawings and will be described in greater detail in what follows.

[014]   Shown are in:

Fig. 1, a schematic representation of a[the] temperature control path with a

first preferred[exemplary] embodiment of the regulating device or the regulating

process of the present invention, in

Fig. 2, a second preferred[exemplary] embodiment of the regulating device or

the regulating process, in

Fig. 3, a third preferred[exemplary] embodiment of the regulating device or the

regulating process, in

Fig. 4, a fourth preferred[exemplary] embodiment of the regulating device or

the regulating process, in

Fig. 5, a further development of the invention in accordance with Figs. 1 to 4

and relating to the inner regulating circuit, in

Fig. 6, a further development of the invention in accordance with Figs. 1 to 4

and relating to the outer regulating circuit, in

Fig. 7, a schematic representation of a running-time based regulator, in

Fig. 8, a detailed depiction of a[detail] portion of the temperature control path

represented in Fig. 1, in

Fig. 9, a first preferred[exemplary] embodiment of a swirling chamber in

accordance with the present invention, in

Fig. 10, a second preferred[exemplary] embodiment of a swirling chamber,

and in

Fig. 11, a third preferred[exemplary] embodiment of a swirling chamber.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[015]　　The temperature of a component 01 of a machine, such as, for example, a printing press, is to be controlled. The component 01 of the printing press is, for example, a part of a printing group, not represented, and in particular is an ink-conducting roller 01 of a printing group. This roller 01 can be embodied as a roller 01 of an inking system, such as, for example, as a screen roller 01, or as a cylinder 01 of the printing group, such as, for example, [as]a forme cylinder 01. The device and the method for temperature control described in what follows can be particularly advantageously employed in connection with a printing group for waterless offset printing, such as[i.e.] in a printing group operating without the use of a dampening agent. In a printing group, and in particular in a printing group for waterless offset printing, the quality of the ink transfer depends particularly on the temperature of the ink and/or of the ink- conducting surfaces, such as, [(]for example, the shell faces of rollers 01 or cylinders 01[)]. Moreover, the quality of

the ink transfer is also sensitive to a splitting speed, such as[i.e.] the number of

revolutions of the machine.

[016]   Temperature control takes place via a temperature control medium, and

in particular via a fluid, such as water, for example, which is brought into thermal

interaction with the component 01 along a temperature control path 02. If the fluid

is to flow against the component 01, the fluid can also be a gas or a gas mixture,

such as air, for example. For temperature control, the fluid is provided to the

component 01 in a first circuit 03, flows through or around the component 01,

absorbs heat, for [(]cooling[)] or gives off heat, for [(]heating[)] and flows back

again, respectively heated or cooled. A heating or cooling unit can be arranged in

this first circuit 03, which can be used for providing the desired fluid temperature.

[017]   In an[the] advantageous embodiment of the present invention, and in

accordance with Fig. 1, however, the first circuit 03 is connected as a secondary

circuit 03 with a second circuit 04, which is a primary circuit 04, and in which circuit

04 the fluid circulates at a defined and mainly constant temperature Tv, for

example a flow temperature Tv. A temperature control device, such as, for

example, a thermostat, a heating and/or cooling unit, or the like[etc.], which

provides the flow[low] temperature Tv, is not represented here. Fluid can be taken

from the primary circuit 04 and metered into the secondary circuit 03 via a

connection 05 between the primary and secondary circuits 04, 03 at a first

connection point 06 of the primary circuit 04 by the use[means] of an actuating

member 07, for example a controllable valve 07. Depending on the amount of any

addition of fresh fluid at the connecting point 06, fluid from the secondary circuit

03 is returned to the primary circuit 04 via a connection 15 at a second connection

point 08. For this purpose, the fluid is, for example, at a higher pressure level in

the area of the first connecting point 06 than it is in the area of the second

connecting point 08. A difference Δ[Delta] p in the pressure level is generated, for

example, by [means of]an appropriate valve 09 between the connecting points

06, 08.

[018]   The fluid, or a larger portion of the fluid, is circulated in the secondary

circuit 03 by the use[means] of a drive mechanism 11, for example by [means of

]a pump 11, a turbine 11 or in another way, on an inflow path 12 through the

component 01, on a return flow path 13 and on a partial path 14 between the

inflow and the return flows paths 12, 13. Depending on the inflow via the valve 07,

after passing through the component 01, an appropriate amount of fluid flows off

via the connection 15 into the secondary circuit 04, or an appropriately reduced

amount of fluid flows through the partial path 14. The portion of the fluid flowing

back through the partial path 14 and the portion of the fluid which is freshly flowing

in via the valve 17 at a feed-in or an injecting point 16 are mixed and now

constitute the fluid which is specifically temperature-controlled for the temperature

control process. To improve[For improving] the intermixing, a swirling section 17,

and in particular a swirling chamber 17, is arranged as closely as possible

downstream of the injection point 16, and in particular between the injection point

16 and the pump 11.

[019]   In the above mentioned case, wherein temperature control is not

performed by [means of]a primary circuit 04, but by [means of]a heating or

cooling unit, the feed-in or the injection point 16 corresponds to the location of the

energy exchange by [means of]the respective heating or cooling unit, and the

actuating member 07, for example, to an output control or the like.   The

connecting point 10 in the circuit 03 is omitted, since the fluid circulates altogether

in the circuit 03, and energy is supplied or removed, or heat or cold is "fed in" at

the feed-in point 16. In this case, the heating or cooling unit corresponds to the

actuating member 07, for example.

[020]   It is intended in the end, by use[means] of the temperature control, to set

or to maintain a defined temperature Θ_3 of the component 01, and in particular in

the case of a cylinder 01, the surface temperature Θ_3 on the roller 01, to a defined

command variable $\Theta_{3,soll}$. This is achieved by measuring a statement- capable

temperature on the one hand, and by a regulation of the supply of fluid from the

primary circuit 04 to the secondary circuit 03 for creating an appropriate mix

temperature on the other hand.

[021]   It is now important that at least two measuring points M1, M2, M3 with

sensors S1, S2, S3 are provided in the instant device, or by the instant method,

between the injection point 16 and an exit of the component 01 to be temperature-

controlled. One[, wherein one] of the measuring points M1 is arranged near the

injection point 16, and at least one of the measuring points M2, M3 in an[the] area

which is close to the component of the inflow path 12 and/or in the area of the

component 01 itself. As a rule, the valve 07, the pump 11, the injection point 16,

as well as the connecting points 06, 08 are arranged spatially close to each other

and are located, for example, in a temperature control cabinet 18, which is

indicated by dashed lines. As a rule, the inflow and the return flow paths 12, 13

between the component 01 and the not explicitly represented exit from, or entry

into the temperature-control cabinet 18 have a comparatively great length in

regard to the other paths, which is indicated in Fig. 1 by respective interruptions.

The locations for the measurements have now been selected in such a way that at

least [respectively]one measuring point M1, respectively, is arranged in the

vicinity of the temperature control cabinet 18, and one measuring point M2, M3 is

arranged near the component, i.e. at the end of the long inflow path 12.

[022]   In the preferred[exemplary] embodiment of the present invention, in

accordance with Fig. 1, the measurement of a first temperature Θ_1 is performed

between the injection point 16 and the pump 11, and in particular between a

swirling section 17 and the pump 11, by [means of]a first sensor S1. A second

temperature Θ_2 is determined by [means of]a second sensor S2 in the area of the

entry into the component 01. In Fig. 1, the temperature Θ_3 is also determined by

measurement, namely by [means of]an infrared sensor, such as [(]IR sensor S3[)]

directed onto the surface of the roller 01. The sensor S3 can also be arranged in

the area of the shell face or, as explained below, possibly can also be omitted.

[023]   Temperature control takes place by [means of]a regulating device 21, or

a regulating process 21, which will be described in greater detail in what follows.

The regulating device 21, as seen in [(]Fig. 1[)], is based on a multi-loop, here a

triple-loop cascade regulation. An innermost regulating circuit has the sensor S1

shortly downstream of the injection point 16, a first regulator R1 and the actuating

member 07, i.e. the valve 07. The regulator R1 is provided with a deviation

Δ[Delta] Θ_1 of the measured value Θ_1 from a [(]corrected[)] command variable

$\Theta_{1,soll,k}$ [(]node K1[)] as the input value and acts, in accordance with its

implemented regulation behavior and/or its regulation algorithm, with an actuating

order Δ[Delta] on the actuating member 07. This means that, depending on the

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deviation of the measured value Θ_1 from the corrected command variable $\Theta_{1,soll,k}$, it

opens or closes the valve 07 or maintains the <u>valve</u> position. The corrected

command variable $\Theta_{1,soll,k}$ is now not directly specified by a control device or

manually, as is otherwise customary, but is formed with the use of an output value

from at least one second, further "outward" located regulating circuit. The second

circuit has the sensor S2 <u>located</u> shortly prior to the <u>fluid</u> entry into the component

01, as well as a second regulator R2. The regulator R3 is provided with a

deviation Δ[Delta] Θ_2 of the measured value Θ_2 at the sensor S2 from a corrected

command variable $\Theta_{2,soll,k}$ [(]node K2[)]] as the input value, and at its output

generates a value $d\Theta_1$ [(]output value $d\Theta_1$[)] in accordance with its implemented

regulation behavior and/or <u>its</u> regulation algorithm, which is used for forming the

above mentioned corrected command variable $\Theta_{1,soll,k}$ for the first regulator R1.

This means that, depending on the deviation of the measured value Θ_2 from the

corrected command variable $\Theta_{2,soll,k}$, an influence is brought to bear by [means of]

the value $d\Theta_1$ on the corrected command variable $\Theta_{1,soll,k}$ of the first regulator R1 to

be formed.

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[024]   In a preferred embodiment of the present invention, the corrected

command variable $\Theta_{1,soll,k}$ for the first regulator R1 is formed at a node K1', [(]for

example by addition, or subtraction[)] from the value $d\Theta_1$ and a theoretical

command variable $\Theta'_{1,soll}$. In turn, the theoretical command variable $\Theta'_{1,soll}$ is

formed in a pre- regulation member in regard to the heat flow V_{WF}. The pre-

regulation member V_{WF}, in this case $V_{1,WF}$ [(]subscript 1 for forming the command

variable of the first regulating circuit[)], takes the heat exchange, such as [(]losses

etc.[)], of the fluid on a partial path into consideration and is based on empirical

values, such as [(]expert knowledge, calibration measurements, etc.[)]. In this

way, the pre-regulation member $V_{1,WF}$ takes the heat or cooling losses along the

partial path between the measuring points M1 and M2 into consideration in that it

forms an appropriately raised or lowered theoretical command variable $\Theta'_{1,soll}$,

which is then processed, together with the value $d\Theta_1$, into the corrected command

variable $\Theta_{1,soll,k}$ for the first regulator R1. A connection between the input value,

i.e. the [(]command variable $\Theta_{3,soll}$ or $\Theta'_{2,soll}$ or $\Theta'_{2,soll,n}$, as discussed[see] below[)],

and a corrected output value, such as a [(]modified command variable $\Theta'_{2,soll}$ or

$\Theta'_{2,soll,n}$, see below, or $\Theta'_{1,soll,n}$()], is fixedly stored in the pre-regulation member V_{WF}, which can preferably be changed by [means of]parameters, or in another way, as needed.

[025]   In principle, a simple embodiment of the regulating device is possible, wherein only the two first mentioned regulating circuits form the cascade regulating device. In this case, the pre-regulation member $V_{1,WF}$ would be specified as the input value by a machine control device, or <u>by</u> a defined command variable $\Theta_{2,soll}$ manually. It would also be used for forming the above mentioned deviation Δ[Delta] Θ_2 upstream of the second regulator R2.

[026]   However, in the embodiment <u>of the invention which is</u> represented in Fig. 1, the regulating device 21 has three cascaded regulating circuits. The corrected command variable $\Theta'_{2,soll,k}$ upstream of the second regulator R2 is now also not directly specified, as <u>is</u> otherwise customary, by a control device or manually. It[, but] is formed with the use of an output value from a third outer regulating circuit. The third regulating circuit has the sensor S3, which detects the temperature on, or in the area of, the shell face, as well as a third regulator R3. The regulator R3

is provided with a deviation $\Delta[\text{Delta}] \, \Theta_3$ of the measured values Θ_3 at the sensor

S3 from a command variable $\Theta_{3,soll}$ [(]node K3[)], as the input value, and

corresponding to its implemented regulation behavior and/or _its_ regulation

algorithm, it generates, at its output, a value $d\Theta_2$ correlated with the deviation

$\Delta[\text{Delta}] \, \Theta_3$, which is also used for forming the above mentioned corrected

command variable $\Theta_{2,soll,k}$ for the second regulator R2. This means that,

depending on the deviation of the measured value Θ_3 from the command variable

$\Theta_{3,soll}$ [(]or _from_ a corrected command variable $\Theta''_{3,soll}$, _as discussed_[see] below[)],

and specified by a machine control device or manually entered, influence is

brought to bear by [means of]the value $d\Theta_2$ on the corrected command variable

$\Theta_{2,soll,k}$ of the second regulator R2 to be formed.

[027]   The corrected command variable $\Theta_{2,soll,k}$ for the second regulator R2 is

formed at a node K2'_, by,_ [(]for example addition, _or_ subtraction[)] from the value

$d\Theta_2$ and a theoretical command variable $\Theta'_{2,soll}$ [(]or $\Theta''_{2,soll}$, see below[)]. In turn,

the theoretical command variable $\Theta'_{2,soll}$ is formed in a pre- regulation member in

regard to the heat flow V_{2WF}. The pre- regulation member V_{2WF}, for example takes

the heat or cooling losses on the partial path between the measuring points M2

and M3 into consideration by forming an appropriately raised or lowered command

variable $\Theta'_{2,soll}$ which then, together with the value $d\Theta_2$, is processed as the

corrected command variable $\Theta_{2,soll,k}$ for the second regulator R2.

[028]   Thus, the above-described method is based, for one, on the

measurement of the temperature directly downstream of the injection point 16, as

well as on at least one measurement taken close to the component 01 whose

temperature is to be controlled. Secondly, a particularly short reaction time of the

regulation is achieved in that several regulating circuits interact in a cascade-like

manner and that [already]in the course of the command variable formation for the

inner regulating circuit, a measured value Θ_2, Θ_3 is taken into consideration.

Thirdly, a particularly short reaction time is achieved by pre-regulation, which

provides empirical values for losses to be expected on the temperature control

path 02. Thus, a regulation circuit, which is located closer to the actuating

member 07, is already provided with a command variable that is appropriately

raised or lowered by an empirical value in expectation of losses.

[029]   In an advantageous embodiment of the present invention, in accordance

with Fig. 2, the regulating device 21 has further pre-regulation devices besides the

pre-regulation member in regard to heat flow $V_{1,WF}$, $V_{2,WF}$.

[030]   As can be seen in Fig. 1, the fluid requires a final running time T_{L2} for the

path from the valve 07 to the sensor S2. Moreover, in the course of actuating the

actuating member 07, the respective mix temperature does not immediately

change to the desired value as a result of, [(]for example, inertia of the valve, or

heating or cooling of the pipe walls and pump[)], but instead is subject to a time

constant T_{e2}. If this time constant, as in the embodiment in accordance with Fig.

1, is not taken into consideration, increased fluctuations of the regulating device

can occur, since, for example, a command for opening the valve 07 was given, but

the result of the opening, namely the addition of respectively warmer or colder

fluid, might not have reached the measuring location of the measuring point M2,

so that the respective regulating circuit continuous to erroneously issue a further

actuating command for opening the valve. The same applies to the path from the

valve 07 to the detection of the temperature by the sensor S3 with the running

time T'_{L3} and <u>with</u> a time constant T'_{e3}, wherein here the marked reference symbol

indicates that this need not be the time until the detection of the fluid temperature

in the area of the roller shell face, but <u>instead may be</u> the time until the detection

of the temperature of the roller surface or <u>of</u> the roller shell.

[031]   Based on the idle time, <u>which</u> [(]corresponds to running time T_{L2} or T'_{L3}[)],

and the time constant T_{e2} or T'_{e3}, the path reactions to the activities of the

innermost regulator R1, toward the level of the two outer regulators R2, R3, do not

become immediately visible. In order to avoid, or <u>to</u> prevent, a double reaction of

these regulators caused by this, which would be exaggeratedly wrong and <u>which</u>

could not be recovered, a pre-regulation member, in regard to the running time

and/or <u>to</u> the time constant V_{LZ} <u>and</u> in the form of a path model member, is

provided in one or <u>in</u> several of the control circuits in the course of forming the

command variable, by <u>the use</u>[means] of which the expected "natural" delay in the

result of a change at the actuating member 07 is taken into consideration. The

running time actually required by the fluid, <u>determined,</u> [(]on the basis of empirical

values or preferably by measured value recordation, or <u>by</u> calculated estimates[)],

is simulated in the regulation by [means of]the pre-regulation member in regard to

the running time and/or to the time constant V_{LZ}. Now, the outer regulators M2,

M3 only react to those deviations which, taking into consideration the modeled

path properties, are not expected and which therefore actually require repair. The

outer regulators R2, R3 are "blinded" by this symmetrization to the regulation

deviations which are expected anyway and which are physically unavoidable, and

of which deviations the innermost regulator R1 already takes care of "locally". In

this way, the "pre-regulation member" V_{LZ} acts in the manner of a "running time

and delay member" V_{LZ}. The above-mentioned dynamic property, [(]running time

and delay[)], is mapped in the pre-regulation member V_{LZ} and is permanently

stored, but can preferably be changed, as needed, by [means of]parameters or in

another way. To this end, appropriate parameters T^*_{L2}, T^*_{e2}, T^*_{L3}, T^*_{e3}, which are

intended to simulate and to represent, for example the actual running time T_{L2}, T'_{L3}

and/or the replacement constant T_{e2}, T_{e3}, can be adjusted at the pre-regulation

member V_{LZ}. The adjustment should take place in such a way that, with this, a

virtual dynamic course of the command variable created by calculation, for

example the command variable $\Theta''_{2,soll}$ or $\Theta''_{3,soll}$, is compared, substantially

synchronously in time, with the corresponding course of the measured value Θ_2 or

Θ_3 of the temperature at the associated sensor S2 or S3 and the node K2 or K3.

[032]   For the outer regulating circuit, the virtual changed command variable

$\Theta''_{3,soll}$ corresponds to the command variable $\Theta_{3,soll,k}$ which is to be compared with

the measured value, since it is not corrected by a further regulating circuit. In the

preferred[exemplary] embodiment, no pre-regulating member V_{LZ} besides it is

provided in the innermost regulating circuit, having [(]very short paths or running

time[)]. In a unification of the nomenclature, here the command variable $\Theta'_{3,soll}$

therefore represents the command variable $\Theta''_{3,soll}$ without any further changes.

[033]   Such a pre-regulation member V_{LZ}, which represents the path model, is

provided at least for forming the command variable for the regulating circuit or the

regulating circuits assigned to the sensor S2, or to the sensors S2, S3 close to the

component. In the example, the two outer regulating circuits have such a pre-

regulating member $V_{LZ,2}$, $V_{LZ,3}$ in their command variable formation process. If the

path between the valve 07 and the sensor S1 should also prove to be too long

and <u>too</u> interfering, it is also possible to provide an appropriate pre-regulation

member $V_{LZ,1}$ in the command value formation process for the inner regulating

circuit.

[034]   A further improvement of the regulating dynamics can be achieved with

the further development of the <u>above</u>-mentioned regulating device, in accordance

with Fig. 3, if the conversion of the desired course of the command variable on the

level of the innermost regulating circuit is made faster and with less of a drag

distance, by a derivative member $V_{VH,1}$ in the form of a time constant exchanger,

for example of the 1st order, <u>such as a</u> [(]lead-lag filter[)]. This pre-regulation, in

the form of the derivative member $V_{VH,\mu}$ initially causes an excess of amplitude, <u>or</u>

<u>an</u> [(]overcompensation[)], in the reaction in order to accelerate the regulating

process in the respective start phase, and then returns to neutral.

[035]   To prevent any stability problems, this step preferably takes place only in

the portion of the command variable not affected by actual values, i.e. ahead of

the respective node K1, K2', [(]addition or subtraction point depending on the

mathematical sign[)]. To maintain this symmetrization at the outer regulators R2,

R3, this dynamic step then must be compensated there by use[means] of

appropriate derivative members $V_{VH,2}$ or $V_{VH,3}$, which act, in addition to the

mentioned pre- regulations V_{WF_1} in regard to the heat flow and V_{LZ_1} in regard to the

running time and/or the time constants during the formation of the command

variable of the subsequent regulating circuit.

[036]   The property of the course of the mentioned excess increase, [(]in

relation to the input signal[)], is mapped in the pre-regulating member $V_{VH,1}$ and is

permanently stored, but its size or course can be changed as needed, preferably

by [means of]parameters or in other ways. In accordance with the physical

sequence, the derivative member $V_{VH,1_1}$ in regard to the signal path, is preferably

arranged ahead of the pre- regulating member V_{LZ_1} [(]if provided[)], and behind the

pre- regulating member V_{WF_1} [(]if provided[)]. The pre-regulation member V_{VH_1} in

accordance with one of the embodiments of Figs. 1 to 4, can also be used

independently of, or in addition to, the presence of the pre-regulation members

V_{LZ}, V_{DZ} or V_{AB_1} [(]see below[)].

[037]   In a further development of the regulating devices of the present

invention, and in accordance with Figs. 1, 2 and 3, a further improvement of the

regulation dynamics can be achieved if, in addition to the above-mentioned pre-

regulating devices V_{WF} in regard to the heat flow, in regard to the running time,

and/or the time constant V_{LZ} and/or the derivative member V_{VH}, a pre- regulation in

regard of the number of revolutions of the machine V_{DZ} takes place, as seen in

[(]Fig. 4[)]. More or less frictional heat is produced in a printing group as a

function of the number of revolutions n of the machine. If it is intended to maintain

the mass flow of the fluid substantially constant, increased frictional heat can only

be generated via a lowering of the fluid temperature, and vice versa. The above

described regulating device would doubtlessly react over time to a change in the

frictional heat by lowering or by increasing the fluid temperature, but only after the

temperature at the sensor S3 indicates the undesired temperature.

[038]   In order to further increase the dynamics of the regulating device 21, in

particular under changing operating conditions, such as during a [(]start-up phase,

during a change in the number of revolutions, or the like[etc.)], the pre-regulating

member V_{DZ} in regard to the number of revolutions is provided, which can

basically be superimposed on all lower-order command valuable formations,

which therefore have an actuating value character, i.e. the formation of the

command variables $\Theta''_{1,soll}$, $\Theta''_{2,soll}$, $\Theta''_{3,soll}$. However, a superimposition of the outer

regulating circuit does not make sense as long as the value measured at the

sensor S3 represents the technologically final valid actual value, [(]for example the

temperature on the effective surface, i.e. on the shell face itself[)]. In the

preferred[exemplary] embodiment, the pre-regulating member V_{DZ} only acts on the

formation of the command variables $\Theta''_{1,soll}$, $\Theta''_{2,soll}$, namely in that a correction

value $d\Theta_n$ is superimposed on the theoretical command variable $\Theta'_{2,soll}$ created in

the pre-regulating member $V_{2,WF}$, which is arranged upstream of the second

regulating circuit. The command variable $\Theta'_{2,soll,n}$, which is created from this, is

used directly, or via appropriate pre-regulation members $V_{VH,1}$ and/or $V_{LZ,1}$, for

forming the command variable of the second regulating circuit [(]R2[)], and

simultaneously via pre- regulating member $V_{WF,1}$, and possibly the pre-regulating

member $V_{VH,I}$ for forming the command variable of the first regulating circuit (R1).

A connection between the number n of revolutions of the machine and a suitable

correction is permanently stored in the pre-regulating member V_{DZ}, which can preferably be changed, as needed, via parameters or in other ways. The pre-regulating member V_{DZ} can also be used in one of the embodiments in accordance with Figs. 1 to 4 independently of the presence of the pre-regulating members V_{LZ}, V_{VH} [(see below)] or V_{AB} [(see below)], or in addition.

[039]   However, if the sensor S3 does not measure the shell face, but measures a temperature further inside of the component [(]which technologically is not the final valid temperature[)], it can also be useful to let the pre-regulation member V_{DZ} also act on the outer regulating circuit, [(]R3[)]. The same applies to an outer regulating circuit which obtains the measured value not directly from the component 01, but from a sensor S4, S5, [(]see Figs. 1 and 5[)], arranged after passage through the component 01, and which is possibly linked with the measured value from S2.

[040]   In a further development, as depicted in Fig. 4, a further pre- regulating member V_{AB}, in the form of a dynamic model member, such as for example, a rise limiter V_{AB}, which, in particular is non-linear, is provided directly ahead of the node

K1 for forming the corrected command variable $\Theta_{1,soll,k}$. It adapts the finite

actuating time, which is [(]not equal to zero[)] and the actual limitation of the

actuating member 07 in respect to its maximal actuating path, i.e. even if a very

great change is requested, to only a limited opening of the valve 07, and therefore

so only a limited amount of temperature-controlled fluid can be provided from the

primary circuit 04. The above-mentioned rise limitation, or [(]property of the

valve[)], is mapped in the pre-regulating member V_{AB} and is permanently stored,

but can preferably be changed via parameters or in other ways, as needed. The

pre-regulating member V_{AB} is also usable independently of the presence of the

pre-regulating members $V_{LZ,1}$, $V_{VH,1}$ or V_{DZ}, or can be additionally used in one of the

embodiments in accordance with Figs. 1 to 3.

[041]   Fig. 5 shows a further development of the above-discussed

embodiments [up to now]of the first regulating circuit, independently of the

embodiments in accordance with Figs. 1, 2, 3 or 4. A measured value Θ_5 of a

sensor 5 is detected close to, or in the area of the partial path 14, i.e. at a short

distance from the injection point 16, and is additionally used for regulation in the

innermost regulating circuit. To this end, the measured value Θ_5 is introduced as

the input value into a further pre-regulating member V_{NU} for dynamic zero point

suppression. The measured value Θ_5 provides information regarding the

temperature, with which the returning fluid will be available, for the impending

mixture with fed-in cooling or heating fluid. If the measured value suddenly greatly

changes, for example if the temperature drops greatly, a correspondingly opposite

signal σ, for example a strong increase of the opening in the valve 07, is created

by [means of]the pre-regulating member V_{NU} and is provided to the regulator R1.

The re-regulating member V_{NU} therefore causes a counteraction to a change

shortly to be expected at the sensor S1 even before it has occurred there. In the

ideal case, this change will not even occur there because of the application of this

interference value.

[042]   The functional progress, and the amplification of the pre-regulating

member V_{NU} regarding this return flow pre- regulation are permanently stored and

can preferably be changed by [means of]parameters.

[043]   Fig. 6 shows a further development of the embodiments up to now of the

outer regulating circuit independently of the embodiments in accordance with Figs.

1, 2, 3 or 4. In contrast to the previous explanations [up to now], a measured

value Θ_3 from a sensor S3, detecting the surface of the component or located in

the shell surface, is not used, but instead the measured values Θ_2 and Θ_4 from

sensors S2 and S4 near the component in the return flow path 12, 13 are used.

These valves are processed, together with a number of revolutions signal n, in a

logical unit L, or in a logical process L, by use[means] of a permanently stored, but

preferably changeable algorithm into $\overline{\Theta_3}$ a replacement measured value Θ_3, for

example the replacement $\overline{\Theta_3}$ temperature Θ_3 of the component 01 (or its surface).

This $\overline{\Theta_3}$ replacement measured value Θ_3 is passed on to the node K3 as $\overline{\Theta_3}$ the

measured value, or temperature Θ_3, in place of the measured value Θ_2,

corresponding to the above mentioned preferred[exemplary] embodiments.

[044]   The regulators R1, R2, R3 from the preferred[exemplary] embodiments

in accordance with Figs. 1 to 4 are embodied in a simple design as PI regulators

R1, R2, R3.

[045]   However, in an advantageous embodiment of the present invention, at

least the regulators R2 and R3 are designed as so-called "running time- based

regulators" or "Smith regulators". The running time- based regulators R2 and R3,

in particular running time-based PI regulators R2 and R3 are represented in Fig. 7

as a replacement circuit diagram and <u>are</u> parameterized. The regulator R2, R3

has the deviation Δ[Delta] Θ_2, Θ_3 as the input value. It is designed as a PI

regulator with a parameterizable amplification factor V_R, whose output signal is fed

back via a replacement constant member G_{ZK} and a running time member G_{LZ}.

[()or as a member as represented with the pre-regulation member V_{LZ}[)].

[046]   The running <u>time</u> or <u>the</u> idle time of the regulating path, as well as its time

constant, is mapped in the running time- based PI regulator R2, R3 and <u>is</u>

permanently stored, but can preferably be changed via parameters or in other

ways, as needed. For this purpose, appropriate parameters T^{**}_{L2}, T^{**}_{e2}, T^{**}_{L3},

T^{**}_{e2}, which, for example, are intended to represent the actual running time T_{L2} or

T_{L3}, and/or the time constant T_{e2}, T_{e3}, can be set at the PI regulator R2 and R3.

With a correct setting and reproduction of the regulating path, the values of the

parameters T^{**}_{L2}, T^{**}_{e2}, T^{**}_{L3}, T^{**}_{e3}, and the values of the parameters T^{*}_{L2}, T^{*}_{e2},

T^*_{L3}, T^*_{e3} from the pre-regulating members $V_{LZ,1\perp}$ in regard to the running time and

the time constant, should substantially agree, since the respective regulating path

is described by them in the regulator R2, R3, as well as in the pre- regulation

member V_{LZ}. Accordingly it is possible to use running time-based PI regulators

R2, R3, as well as pre- regulating members V_{LZ} in the regulating device, and the

same parameter sets, once determined, should be used for both.

[047]   The first section 12.1 extends from the injection point 16 as far as the

first measuring point M1 with the first sensor S1 and has a path length X1, as well

as a first average running time T_{L1}. The second section 12.2 extends from the first

measuring point M1 up to a measuring point M2 "near the component", with the

sensor S2. It has a second path length X2, as well as a second average running

time T_{L2}. The third section 12.3 with a third path length X3, as well as a third

average running time T_{L3}, adjoins the measuring point M2 and extends to the

destination 22 (here the first contact of the fluid in the area of the extended shell

face). A total running time T of the fluid from the injection point 16 to the

destination therefore results from $T_{L1} + T_{L2} + T_{L3}$.

[048]   The first measuring point M1 has been selected "close to the feed-in

point", i.e. at a short distance from the feed-in point 16, here the injection point 16.

Thus, a measuring point M1 close to the feed-in point, or a sensor S1 close to the

actuating means is understood to be a location in the area of the inflow path 12,

which is located in regard to the running time T_L of the fluid less than one tenth, in

particular one-twentieth, of the distance from the feed-in point 16 to the first

contact with the destination 22 (here the first contact of the fluid in the area of the

extended shell face), i.e. $T_{L1} < 0.1\ T$, in particular $T_{LI} < 0.5\ T$ applies. For a high

degree of regulation dynamics, the measuring point M1 is located in respect to the

running time T_{L1} of the fluid maximally 2 seconds, in particular maximally 1

second, distant from the injection point 16. As already mentioned in connection

with Fig. 1, the injection point 16, the sensor S1, as well as the downstream

arranged pump 11, are arranged in a temperature-control cabinet 18, which

constitutes a structural unit of the contained units. The measuring point M1 is

preferably located upstream of the pump 11. The temperature-control cabinet 18

can be connected with the component 01 via releasable connections 23, 24 in the

inflow path 12, as well as the return flow path 13.

[049]   As a rule, the component 01 and the temperature-control cabinet are not

arranged directly adjoining each other in the machine, so that a line 26, for

example pipes 26 or a hose 26, from the temperature-control cabinet 18 to an

entry 27 into the component 01, for example to a lead-through 27, in particular a

rotary lead-through 27, has a length of appropriate size. The lead-through into the

roller 01 or the cylinder 01 is only schematically indicated in Fig. 8. If, as is

customary, the roller 01 or the cylinder 01 has a journal at its front face, the lead-

through is provided through the journal. The path of the fluid to the shell face, as

well as inside the component 01 along the shell face is only symbolically

represented and can extend in a known manner, for example in axial or helical

conduits, in extended hollow chambers, in a circular ring cross section, or in other

suitable ways underneath the shell face. The second measuring point M1 is

"close to the component", i.e. selected at a short distance from the component 01,

or the destination 22, in this case the shell face. Therefore a second measuring

point M2, or a second sensor S2, close to the component, is understood to be a

location in the area of the inflow path 12 which, in respect to the running time of

the fluids, is farther removed than half the distance from the injection point 16 to

the first contact with the destination (here the first contact of the fluid in the area of

the extended shell face). $T_{L2} > 0.5\ T$ applies here. In order to obtain great

dynamics of the regulation, simultaneously along with low structural outlay at

rotating components 01, the second measuring point M2 is arranged in the area of

the line 26 fixed in place, yet outside of the rotating component 01, but is still

located directly, i.e. distanced maximally three seconds in regard to the running

time of the fluid, upstream of the entry 27 into the component 01.

[050]   The third measuring point M3, if provided, is also arranged at least "close

to the component", but in particular "close to the destination". This means that it

is located in close vicinity to the destination 22 of the fluid, or directly detects the

surface to be temperature-controlled (in this case the shell face of the roller 01).

In an advantageous manner the measuring point M3 does not detect the fluid

temperature, such as is the case with the measuring points M1 and M2, for

example, but the area to be temperature controlled of the component 01 itself.

The direct vicinity of the destination 22 is here understood to mean that the sensor

S3 is located between the fluid circulating in the component 01 and the shell face,

or detects the temperature Θ_3 on the shall face in a contactless manner.

[051]   In another embodiment of the temperature-control device it is possible to

do without the measuring point S3. It is possible to draw conclusions regarding

the temperature Θ_3 from empirical values by means of the measured values of the

measuring point M2, for example by means of a stored connection, an offset, a

functional interrelationship. Then, for a desired temperature Θ_3 a regulation to a

desired temperature Θ_2 is performed, taking into consideration the machine or

production parameters (inter alia the number of revolutions of the machine,

ambient temperature and/or fluid throughput, (doctor blade) coefficient of friction,

heat progress resistance).

[052]   In a further embodiment the measuring point 3 is again omitted, but

conclusions regarding the temperature Θ_3 are drawn from empirical values by

means of the measured values at the measuring point M2 and the measuring

point M4, for example again from a stored connection, an offset, a functional

interrelationship and/or by forming an average value from the two measured

values. Then for a desired temperature Θ_3, a regulation to a desired temperature

Θ_2 as the command variable is performed again, either by taking into

consideration the machine or production parameters (inter alia the number of

revolutions of the machine, ambient temperature and/or fluid throughput), or to the

temperature Θ_3 indirectly determined by means of the two measured values. In

Fig. 8, the inflow and outflow of the fluid into or out of the component 01 embodied

as a roller 01 or a cylinder 01 are located on the same front face. Accordingly, the

rotary leadthrough is embodied here with two connectors or, as represented, with

two leadthroughs arranged coaxially inside each other and coaxially in respect to

the roller 01. The measuring point M4 is also arranged as closely as possible to

the leadthrough.

[053]   In the advantageous embodiment of the temperature- control device, it

has a swirling section 17, in particular a specially designed swirling chamber 17, in

the section 12.1 between the feed-in point 16 and the first measuring point M1.

As already mentioned above, the measuring point M1 should be arranged close to

the feed-in point, so that as rapid as possible reaction times can be realized in the

respective regulation circuit with the measuring point M1 and the actuating

member 07. However, on the other hand a homogeneous mixture between the

fed-in and the returning fluid (or the heated/cooled fluid) has not yet been

achieved closely downstream of the feed-in point, so that errors in the measured

values make regulation difficult, and possibly considerably delay reaching of the

desired temperature Θ_3 at the component 01.

[054]   The employment of the swirling section 17, in particular of the specially

designed swirling chamber 17, in accordance with Figs. 9 and 10 assures in a

simple manner a dependably mixing of the fluid over a very short distance, so that

the above mentioned requirement regarding a short running time T1 can be met.

[055]   Initially, a first cross-sectional change takes place in the smallest

structural space, wherein a first cross- sectional surface A1 is suddenly increased

by a factor f1 = 2 to a second cross-sectional surface A2. Directly adjoining a

change in direction of 70° to 110° takes place, in particular abruptly by

approximately 90°, which is followed by a second cross-sectional change, namely

a reduction from the cross- sectional surface A2 to the cross-sectional surface A3

by a factor f2 (f2<1). The factor f2 is advantageously selected as f2 ≤ 0.5 and has

been selected complementary to the factor f1 in such a way that the two cross-

sectional surfaces A1, A3 upstream and downstream of the swirling chamber 17

are substantially of the same size.

[056]   Fig. 9 shows an embodiment of the swirling chamber 17 with pipe-

shaped inlet and outlet areas 29, 31, wherein non- represented pipe-shaped lines

with a cross-sectional surface A1 here terminate in centrally arranged openings

32, 33 as the inlet 32 and outlet 33. The joining line of the pipe- shaped inlet and

outlet areas 29, 31 does not form a curved pipe with a steadily extending

curvature, but instead is embodied with a bent-off edge at least in a plane

constituted by the flow directions in the inlet and outlet area (see the bend 36, 37).

In a further development, the openings 32, 33 can also be placed non-centered in

the surfaces A2, A3.

[057]   Fig. 10 shows a preferred[an exemplary] embodiment wherein the

swirling chamber 17 is embodied with the geometry of a joint between two box-

shaped pipes. Here, again, two surfaces A2 have respective openings 32, 33.

Here, too, the directional change in the area of the existing or "imaginary" joint 34

between the inlet and the outlet surface has been embodied with (sharp) edges

(see bend 36, 37). Again, the openings 32, 33 can be asymmetrically arranged in

the surfaces A2.

[058]   Fig. 11 shows a preferred[an exemplary] embodiment wherein the

swirling chamber 17 is embodied with the geometry of a cube, in a special design

in Fig. 10 as a cube with identical lengths of the lateral edges. In this case two

adjoining surfaces A2 each have the openings 32, 33. Here, too, the direction

change in the area of the "imaginary joint" (34) between the inlet and the outlet

areas is embodied with (sharp) edges (see bend 36, 37). Here, too, the openings

32, 33 can be asymmetrically arranged in the surfaces A2.

[059]   While preferred embodiments of a temperature control method, a

regulating device, and a temperature control device, in accordance with the

present invention have been set forth fully and completely hereinabove, it will be

apparent to one of skill in the art that various changes in, for example, the source

of supply of the temperature control fluid, the specific structure of the printing

press, and the like could be made without departing from the true spirit and scope

of the present invention which is accordingly to be limited only by the following

claims.

WHAT IS CLAIMED IS:

[List of Reference Symbols

01	Component, roller, screen roller, cylinder, forme cylinder
02	Regulating path, temperature-control path
03	Circuit, first, secondary circuit
04	Circuit, second, primary circuit
05	Connection
06	Connecting point, first
07	Actuating member, valve
08	Connection point, second
09	Valve, differential pressure valve
10	Connection point
11	Drive mechanism, pump, turbine
12	Inflow path
12.1	Section, first
12.2	Section, second
12.3	Section, third
13	Return flow path
14	Partial path
15	Connection
16	Feed-in point, injection point
17	Swirling section, swirling chamber
18	Temperature-control cabinet
19	-
20	-
21	Regulating device, regulating process
22	Destination
23	Connection, releasable
24	Connection, releasable
25	-]

[26   Line, pipes, hose

27   Entry, leadthrough, rotary leadthrough

28   -

29   Inlet area

30   -

31   Outlet area

32   Opening, inlet

33   Opening, outlet

34   Joint line

35   -

36   Bend

37   Bend

A1 to A3   Surfaces, cross-sectional surfaces

K1 to K3   Nodes

K1' to K2' Nodes

M1 to M5   Measuring points

R1 to R3   Regulators

S1 to S5   Sensors

T_{ei} Time constant (subscript i denotes the
regulating circuit)

T^{*}_{ei} Parameter, replacement constant (subscript i
denotes the regulating circuit)

T^{**}_{ei} Parameter, replacement constant (subscript i
denotes the regulating circuit)

T_{Li} Running time, fluid (subscript i
denotes the regulating circuit)

T'_{3} Running time, temperature response at the
sensor S3

T^{*}_{Li} Running time, fluid (subscript i
denotes the regulating circuit)

T^{**}_{Li} Running time, fluid (subscript i
denotes the regulating circuit)]

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[T_V Temperature, flow temperature

V_{AB} Pre-regulating member

V_{NU} Pre-regulating member

V_{DZ} Pre-regulating member

$V_{(i)VH}$ Derivative member (subscript i denotes the control circuit, if provided)

$V_{(i)WF}$ Pre-regulating member (subscript i denotes the control circuit, if provided)

$V_{(i)LZ}$ Pre-regulating member (subscript i denotes the control circuit, if provided)

n   Number of revolutions of the machine

$d\Theta_i$ Value, initial value

DeltaΘ_i Deviation

Θ_i Temperature, measured value (subscript i denotes the control circuit)

$ Θ_3   Temperature, measured value, replacement temperature, replacement measured value

$\Theta_{3,soll}$ Command variable, third regulating circuit

$\Theta_{i,soll,k}$ Command variable, corrected (subscript i denotes the control circuit)

$\Theta'_{i,soll}$ Command variable, theoretical (subscript i denotes the control circuit)

$\Theta'_{i,soll,n}$ Command variable (subscript i denotes the control circuit)

Delta   Actuating command

Delta p Difference in the pressure level]